CLAIMS:

1. Apparatus for cancelling radio frequency noise occurring in a communications channel, comprising input means (10,12,16,26) for connection to the communications channel (14) and for extracting therefrom a differential signal (S) and a common mode signal (CM), narrowband noise estimation means (28) responsive to the common mode signal (CM) for producing a first noise estimate signal (E_A) derived from relatively high amplitude narrowband radio frequency interference in one or more narrow frequency bands and wideband noise estimation means (30) responsive to the common mode signal for producing a second noise estimate signal (E_D) derived from relatively low amplitude wideband radio frequency interference in frequency bands other than said one or more narrow frequency bands, control means (60) for controlling gain and/or phase of the noise estimate signals in relation to the differential signal (S), means (48) for subtracting the first and second noise estimate signals from the differential signal, and means for compensating for phase differences between the common mode component in the differential signal and each of the first and second interference estimate signals before the signals are summed or added.

2. Apparatus according to claim 1, wherein the compensating means comprises an analog delay unit interposed between the input means and the first summing device for compensating for delay introduced in the narrowband noise estimation means and a digital delay interposed between the first summing device and the adder for compensating for delay introduced by the wideband noise estimation means.

3. Apparatus according to claim 1, wherein the narrowband estimation means (28) provides an analog first estimation signal (E_A) and the wideband noise estimation means (30) provides a digital second noise estimation signal (E_D).

4. Apparatus according to claim 1, wherein the narrowband noise estimation unit (28) comprises a plurality of bandpass filter means (34/1,34/2,34/3) each for passing a respective common mode signal component in a corresponding one of a plurality of said narrow frequency bands and means (36/1,36/2,36/3,38/1,38/2,38/3) for adjusting gain

and phase of each of the common mode signal components in response to control signals (P,G) from the control means (60).

5. Apparatus according to claim 1, wherein the narrowband noise estimation unit (28) comprises a plurality of bandpass filter means (34/1,34/2,34/3) each for passing a respective common mode signal component in a respective one of said plurality of narrow frequency bands, means (66) for summing the common mode signal components, an analog-to-digital converter (68) for converting the summed common mode signal components to a corresponding digital signal, adaptive filter means (70) responsive to a control signal (A) from the control unit (60) for adjusting gain and/or phase of the digital signal relative to the differential signal, and a digital-to-analog converter (72) for converting the adjusted digital signal to produce said second noise estimate signal (E_A).

6. Apparatus according to claim 4, wherein the filter means (34/1,34/2,34/3) are adjustable in response to a frequency control signal (F) from the control means (60) so as to tune their respective pass bands to the frequency bands in which the noise occurs.

7. Apparatus according to claim 5, wherein the filter means (34/1,34/2,34/3) are adjustable in response to a frequency control signal (F) from the control means (60) so as to tune their respective pass bands to the frequency bands in which the noise occurs.

8. Apparatus according to claim 1, wherein the control unit (60) selects blocks of the digitized differential signal having a predetermined number of samples, derives a power spectral density envelope (PSD) for each block, and compares the power spectral density envelope with a predetermined spectral mask to determine said one or more narrow frequency bands.

9. Apparatus according to claim 1, further comprising switching means (64) controlled by the control unit (60) for selecting either the difference ($S-E_A$) between the differential signal and the first noise estimation signal or the difference ($S-E_A-E_D$) between the differential signal and the sum of the first and second noise estimation signals in dependence upon the presence or absence of a predetermined level of common mode interference in the differential signal.

10. A method of cancelling radio frequency noise occurring in a communications channel using a noise cancellation circuit having input means (10,12,16,26) for connection to the communications channel (14), further comprising the steps extracting from the channel via the input means a differential signal (S) and a common mode signal (CM), deriving a first noise estimation signal from relatively high amplitude narrowband radio frequency interference in one or more narrow frequency bands of the common mode signal (CM), deriving from the common mode signal a second noise estimate signal (E_D) from relatively low amplitude wideband radio frequency interference in frequency bands of other than said one or more narrow frequency bands, controlling gain and/or phase of the noise estimation signals in relation to the differential signal (S), subtracting the first and second noise estimation signals from the differential signal, and compensating for phase differences between the common mode component in the differential signal and each of the first and second noise estimation signals.

11. A method according to claim 10, wherein the compensation is provided by delaying the differential signal by a first analog delay corresponding to delay introduced by the narrowband noise estimation step and by delaying the resulting difference signal using a digital delay for compensating for delay introduced by the wideband noise estimation step.

12. A method according to claim 10, wherein the first noise estimation signal (E_A) is analog and the second noise estimation signal (E_D) is digital.

13. A method according to claim 10, wherein the first noise estimation signal is obtained by passing the common mode signal through a plurality of bandpass filter means (34/1,34/2,34/3) each for passing a respective common mode signal component in a corresponding one of a plurality of said narrow frequency bands and adjusting gain and phase of each of the common mode signal components in response to control signals derived in dependence upon cross-correlation between the common mode signal and the difference signal ($S-E_A$).

14. A method according to claim 10, wherein the first noise estimation signal is obtained by passing the common mode signal through a plurality of bandpass filter means

(34/1,34/2,34/3) each for passing a respective common mode signal component in a respective one of said plurality of narrow frequency bands, summing the common mode signal components, converting the summed common mode signal components to a corresponding digital signal, using an adaptive filter means (70) to adjust gain and/or phase of the digital signal relative to the differential signal, and converting the adjusted digital signal to produce said second noise estimation signal (E_A).

15. A method according to claim 13, further comprising the step of adjusting the filter means (34/1,34/2,34/3) so as to tune their respective pass bands to said one or more narrow frequency bands of the common mode signal.

16. A method according to claim 14, further comprising the step of adjusting the filter means (34/1,34/2,34/3) so as to tune their respective pass bands to said one or more narrow frequency bands of the common mode signal.

17. A method according to claim 10, wherein the one or more narrow frequency bands are determined by selecting at least one block of the digitized differential signal having a predetermined number of samples, deriving a power spectral density envelope (PSD) for the block, comparing the power spectral density envelope with a predetermined spectral mask and determining said one or more narrow frequency bands as those in which the envelope exceeds the mask.

18. A method according to claim 10, further comprising the step of selecting either the difference ($S-E_A$) between the differential signal and the first noise estimation signal or the difference ($S-E_A-E_D$) between the differential signal and the sum of the first and second noise estimation signals in dependence upon the presence or absence of a predetermined level of common mode interference in the differential signal.